Management of Slope Failures Using a Geographical Information System

Presented at

By

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Topics

- Background
- Research Methodology
- Interim Results
- Direction of Future Work

Highway 71 Relocation (I-540)

- 69 Km of Interstate Quality Road
  - Two-3.6 m Lanes
  - 3m Right Shoulder
  - 1.2m Left Shoulder
  - 5% Maximum Grade
- 13 Major Bridges
- 430m Twin Bore Tunnel
- $440 Million Initial Cost
- $42+ Million in Slope Repairs

Background

- Significant Number of Failures
- Large Maintenance Expenditures
- Unsightly
- User Confidence
- Threat to Safety

Collection of Failure Data

- Surveys to 10 Highway Districts
  - Location
  - Magnitude
  - Corrective Action
  - Failure Parameters
- Personal Interviews with Maintenance Supervisors

Data Collectors

David Ross

Wing Fatt Siew

Field Data Collection

- Global Positioning System
- Slope Geometry
- Failure Limits
- Soil Conditions
- Drainage
- Ground Cover

GIS Issues

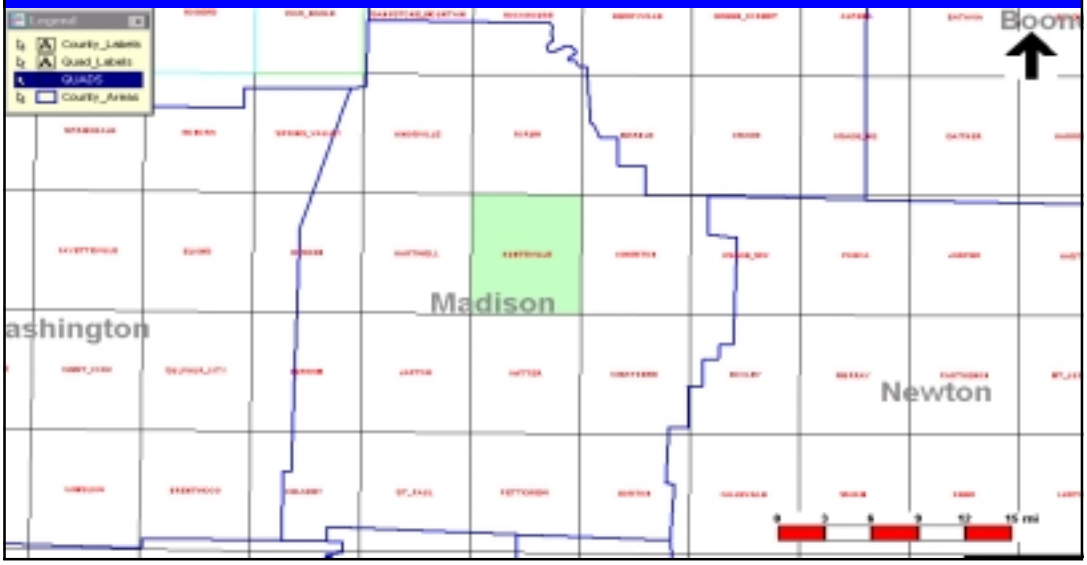
- MGE
- Microsoft Access
- Geo Media
- MF Works

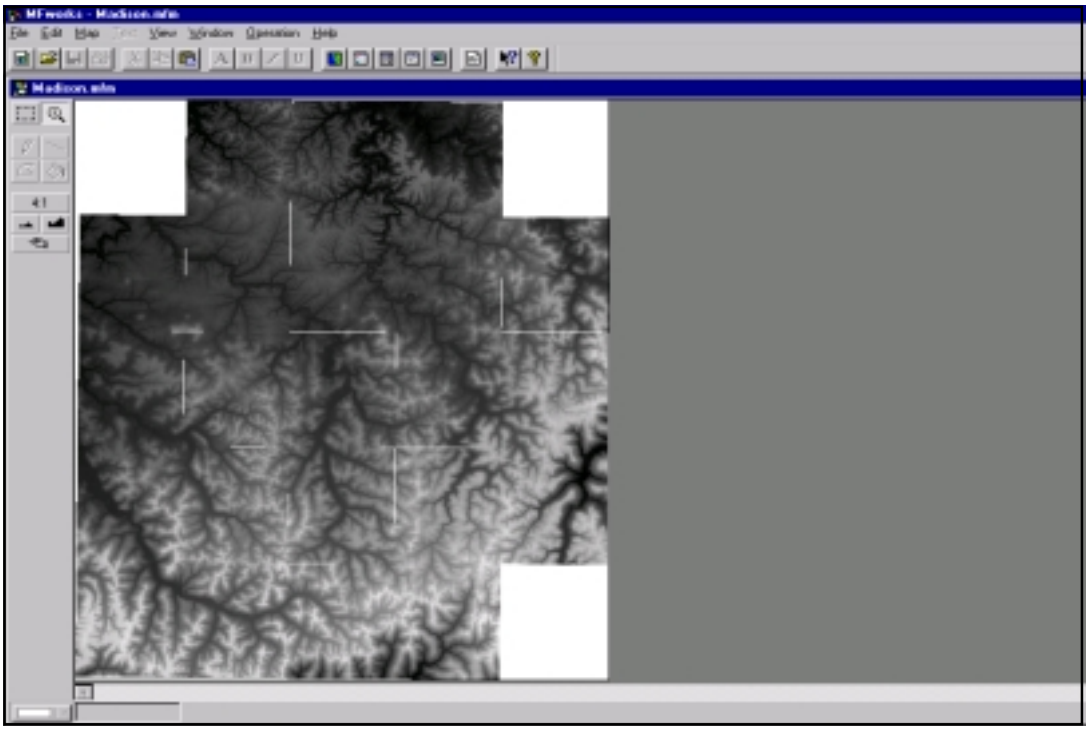
- Arcview

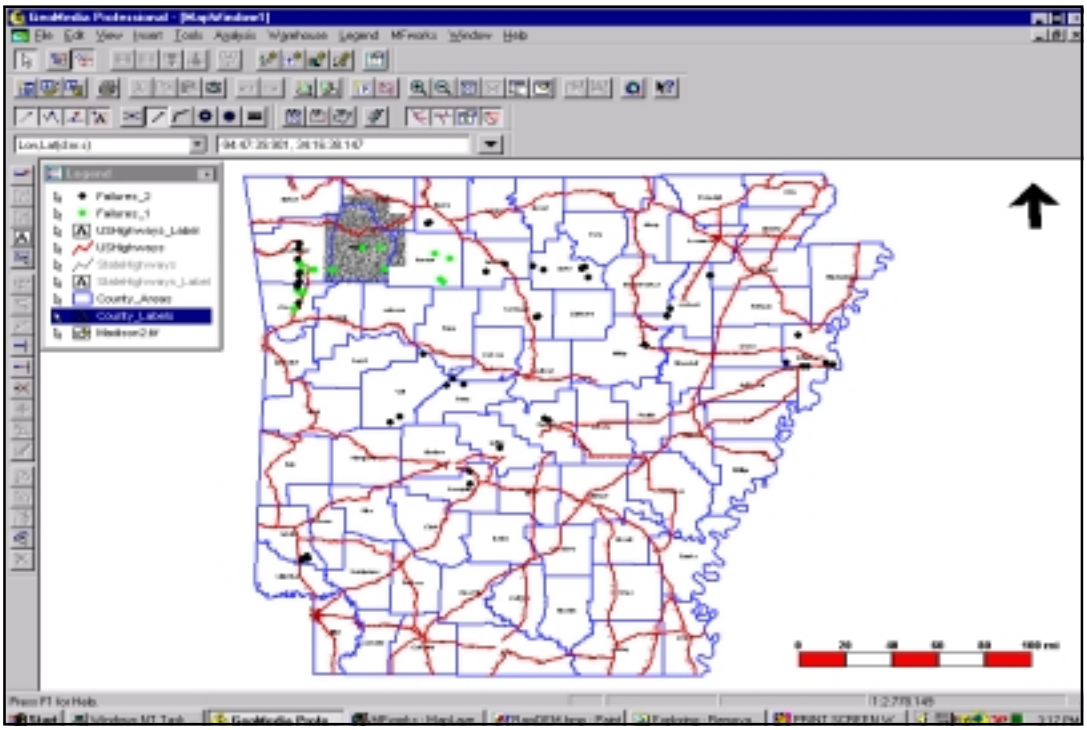
Data Warehouse

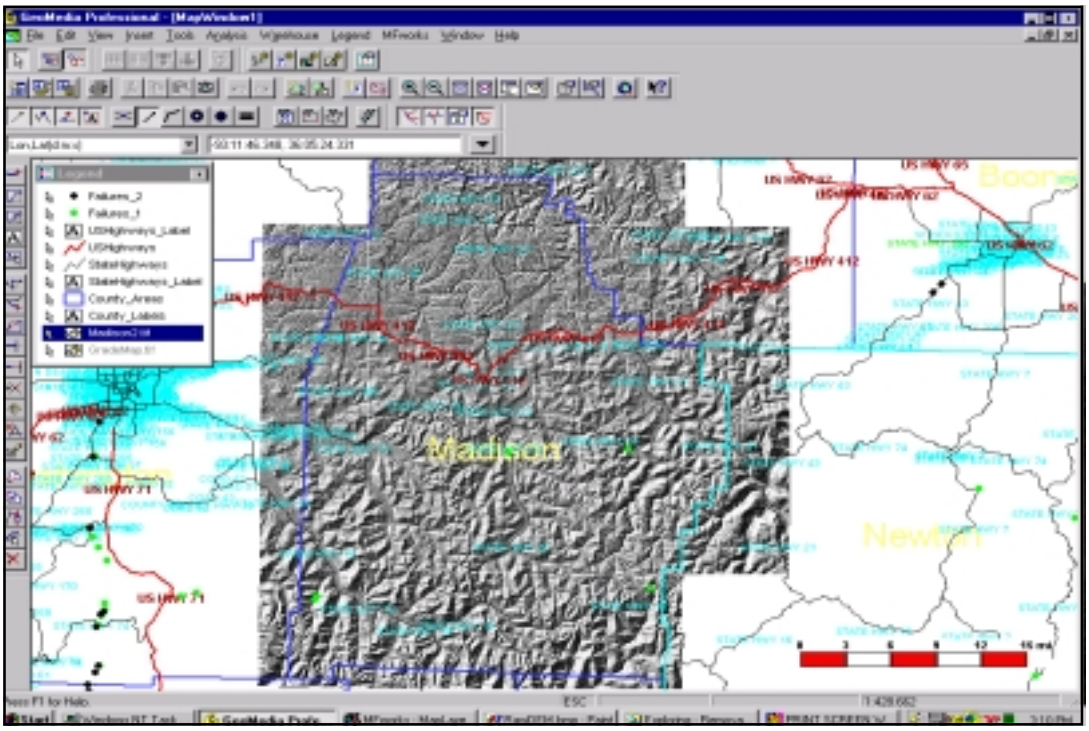
- Tiger Line Files
- Streams and Seeps
- Ground Cover
- Surface Soils
- Geology
- DEM

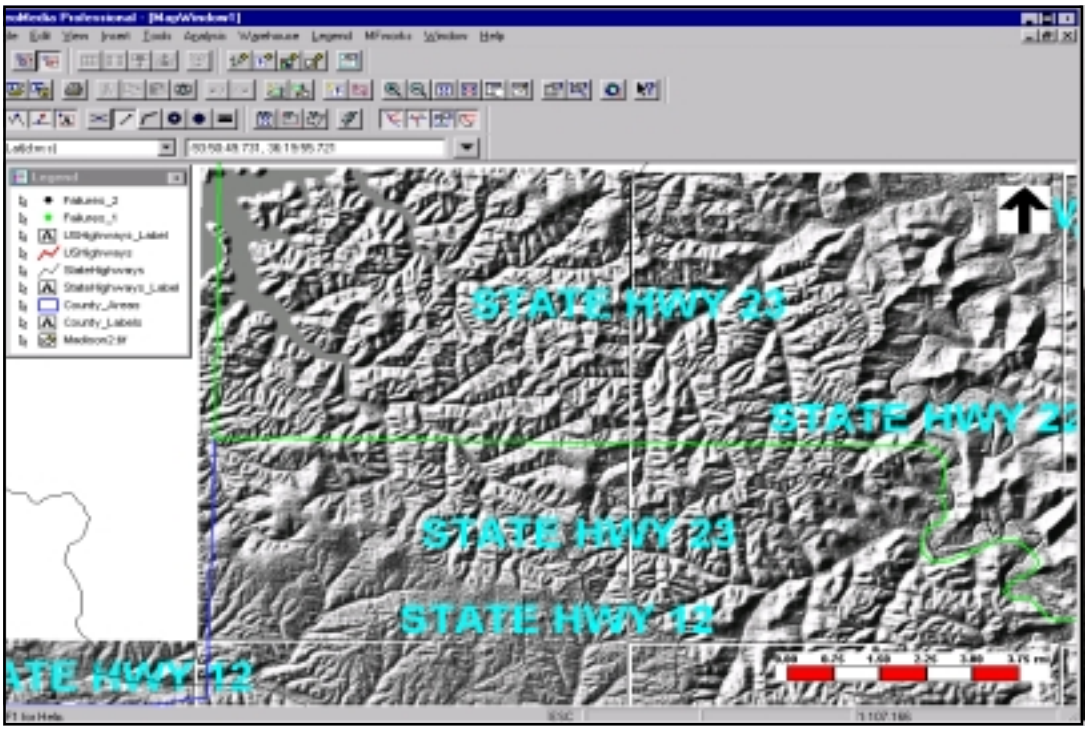
Quadrangle Grid

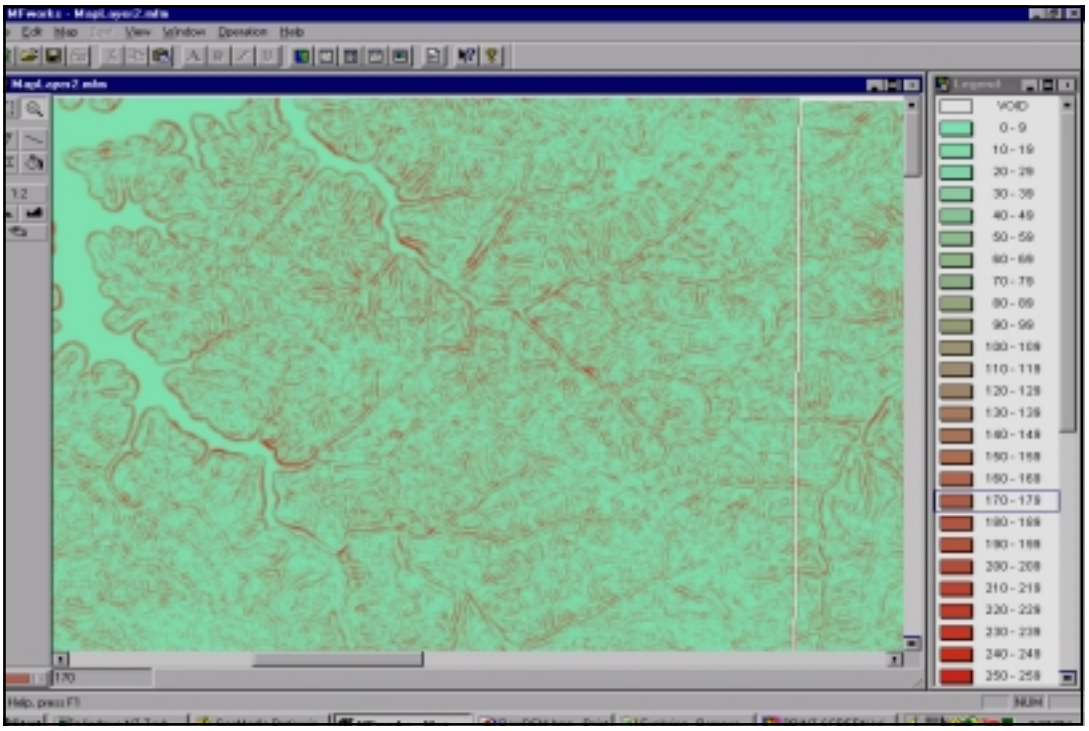







Madison
Newton


STATE HWY 23
STATE HWY 23
STATE HWY 12


VOID
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10 - 19
20 - 29
30 - 39
40 - 49
50 - 59
60 - 69
70 - 79
80 - 89
90 - 99
100 - 109
110 - 119
120 - 129
130 - 139
140 - 149
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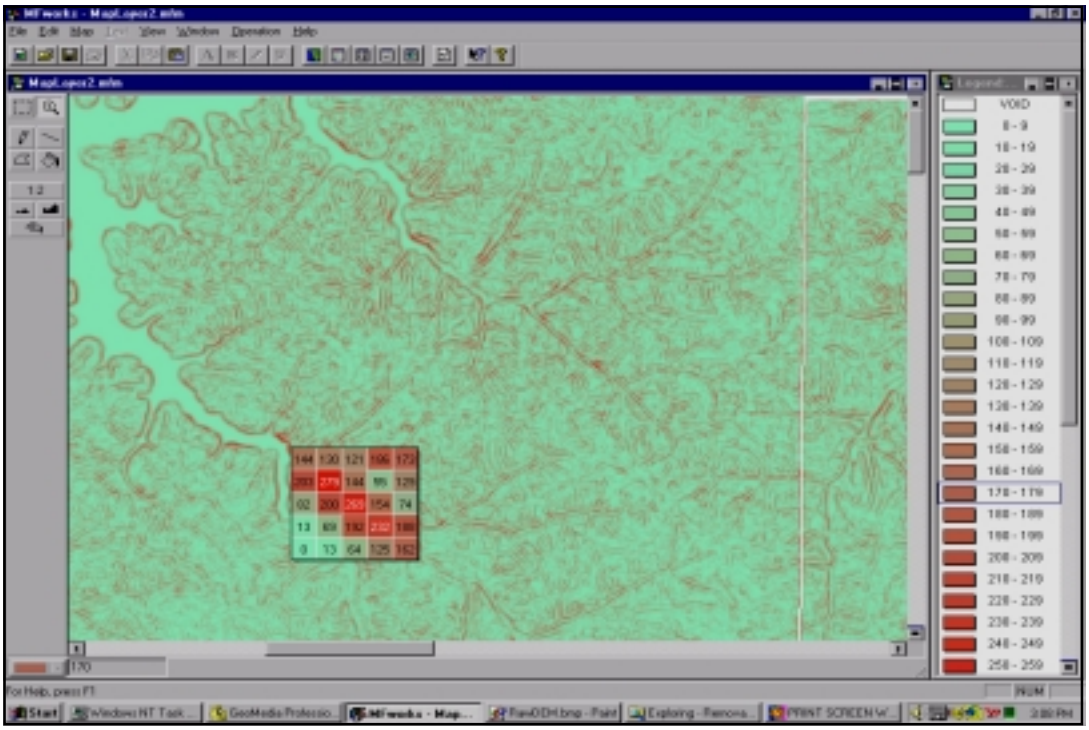
230 - 239
240 - 249
250 - 259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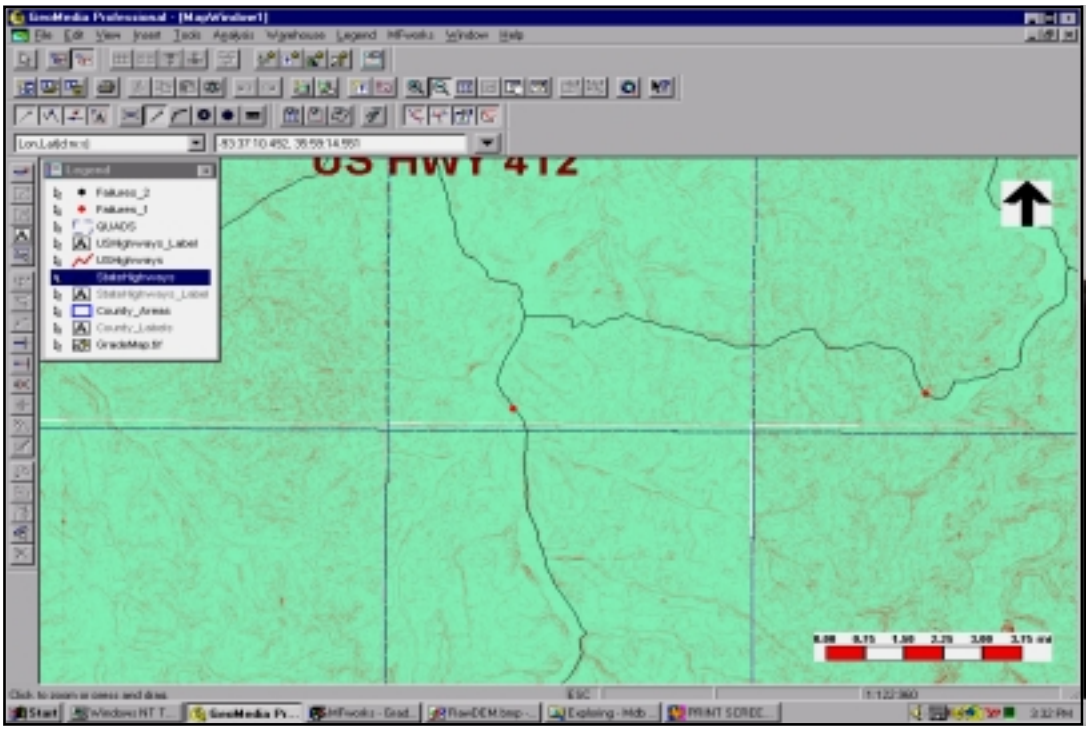
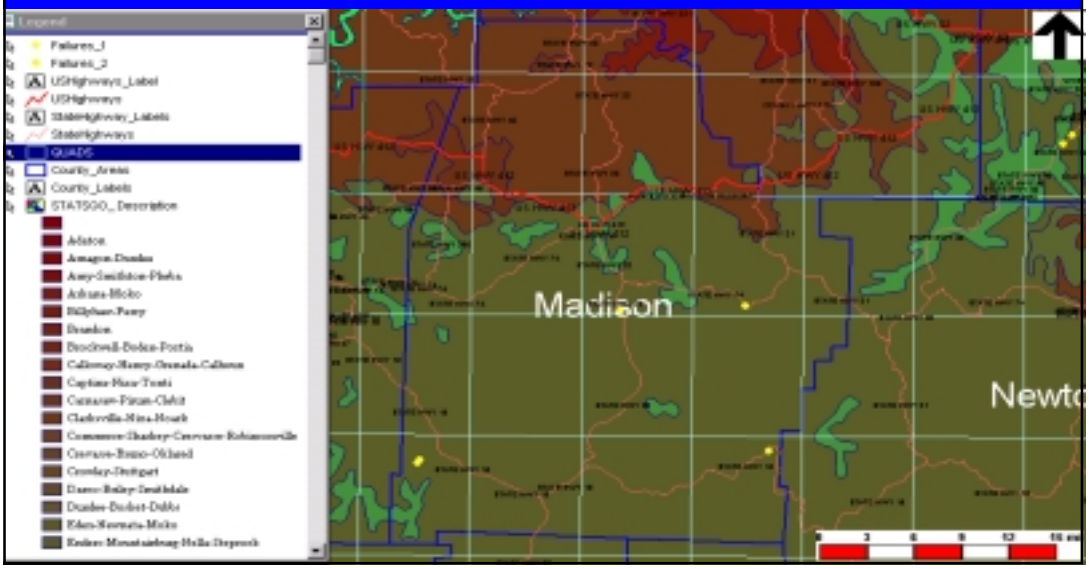
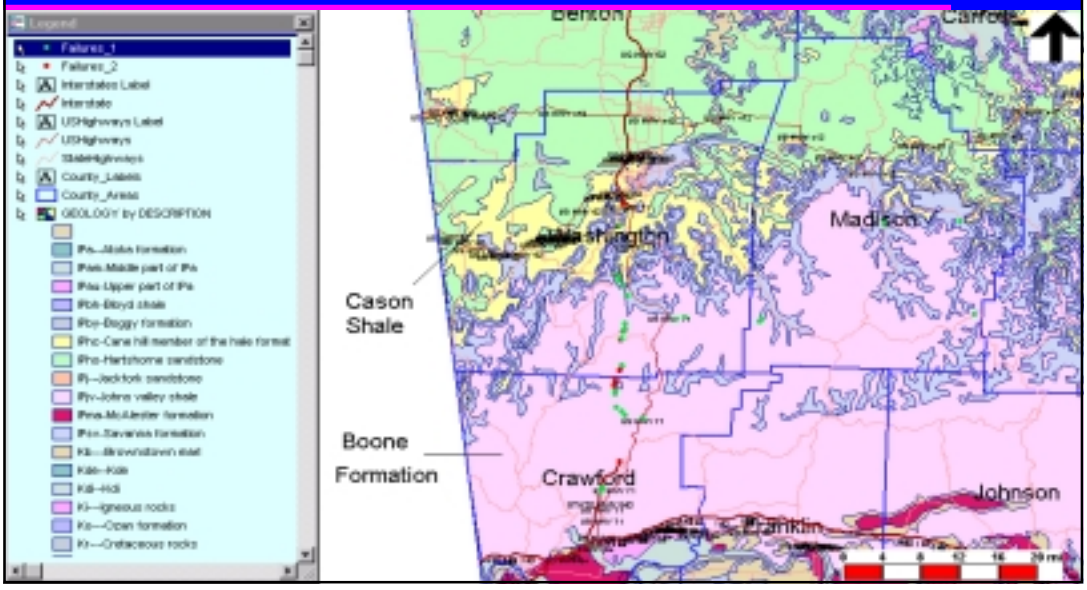


State Level Soil Data



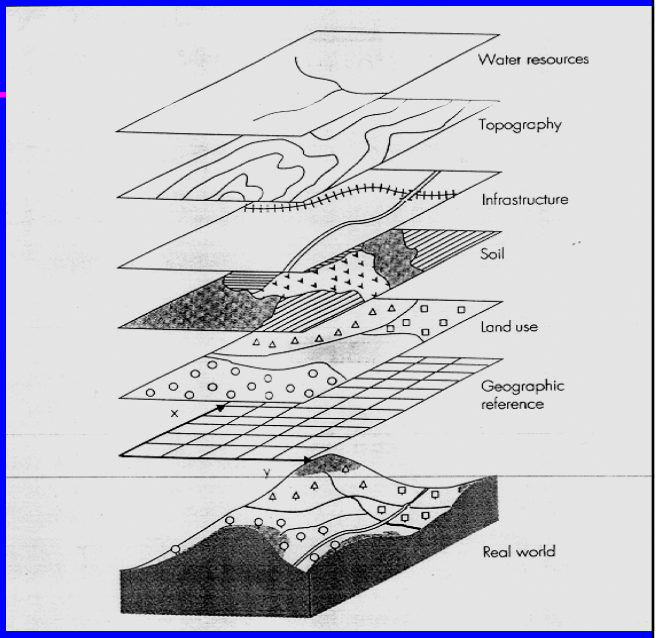
County Level Soil Data

Geological Data



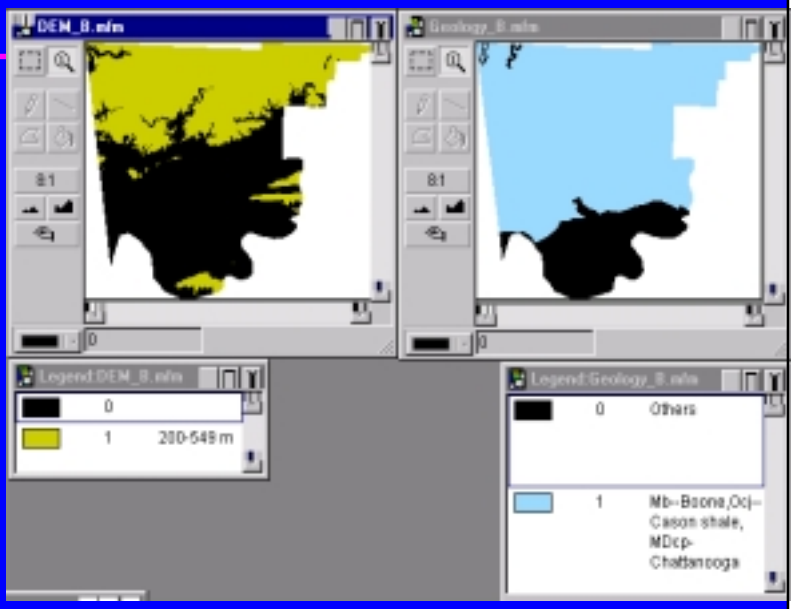
Overlay Analysis

- County Boundaries
- DEM
- Geology
- Soil
- Land Cover
- Water



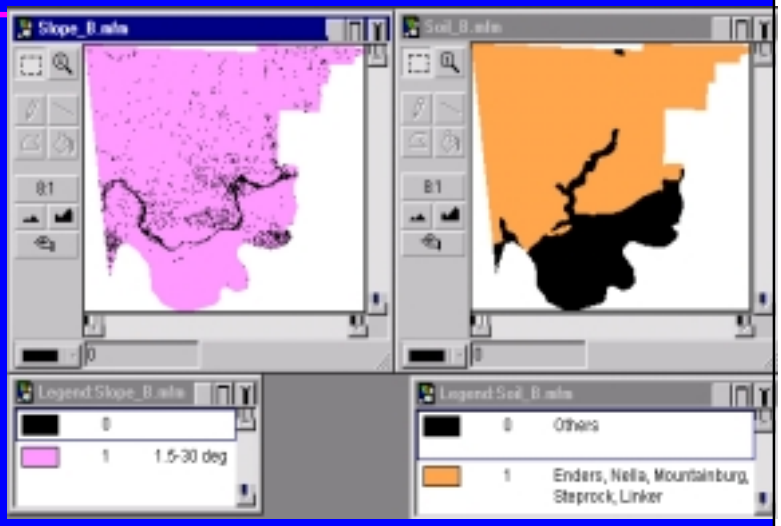
Boolean Layers

- Elevation
  - 200-500m
- Geology
  - Boone
  - Carson
  - Chattanooga



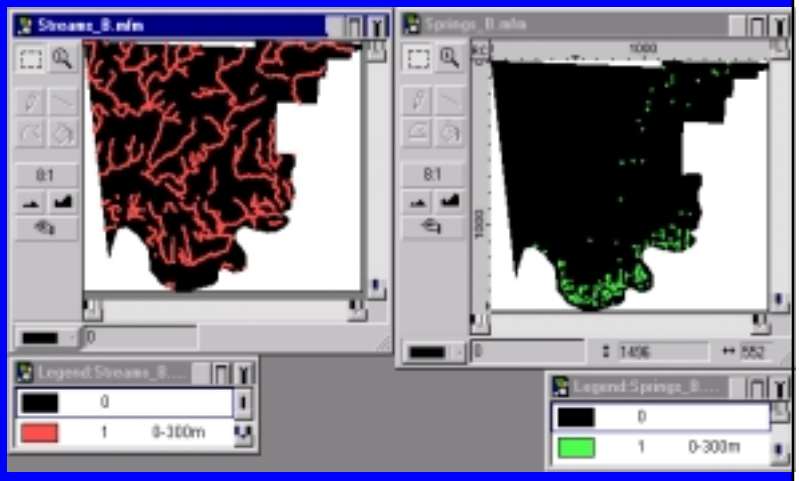
Boolean Layers (cont.)

- Gradient
  - 1.5-30 %
- Soil Type
  - Enders
  - Nella
  - Mountainburg
  - Linker

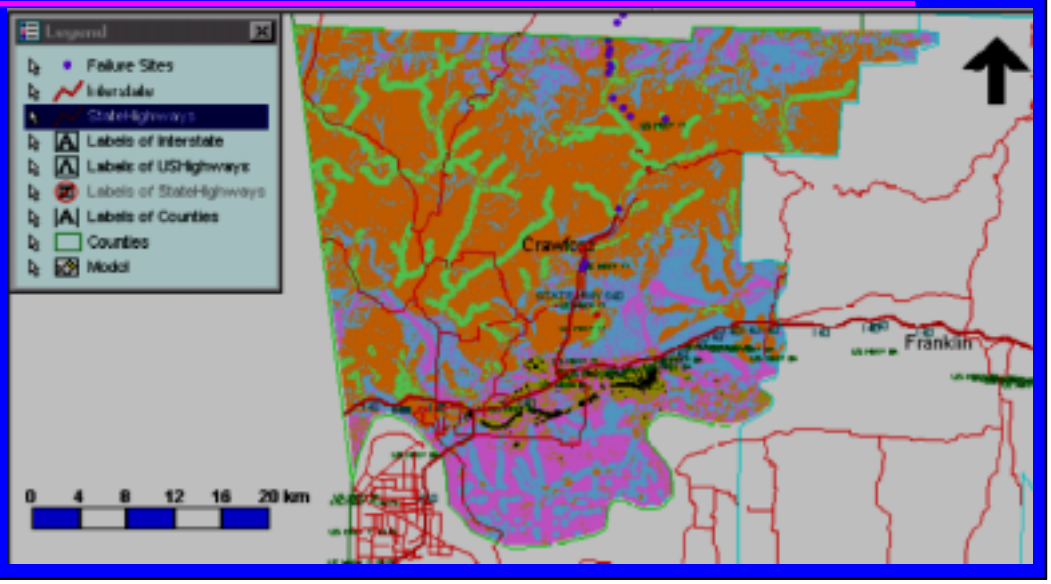


Boolean Layers

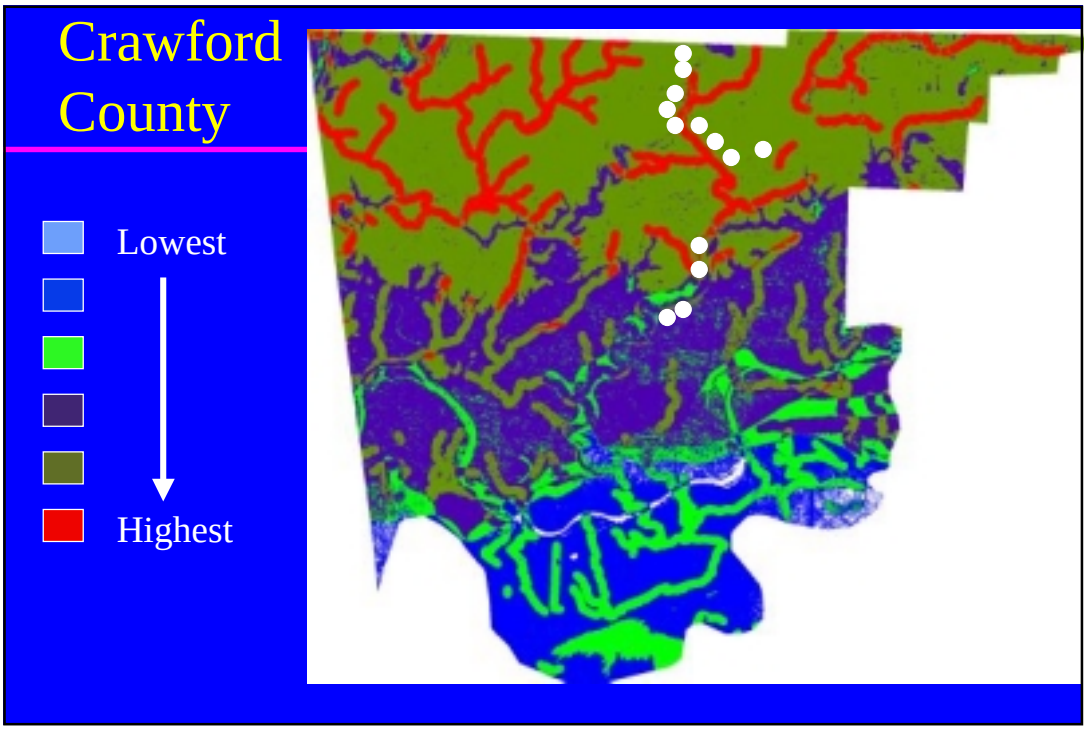
- Streams
- Springs and Seeps



Example of Final Boolean Overlay



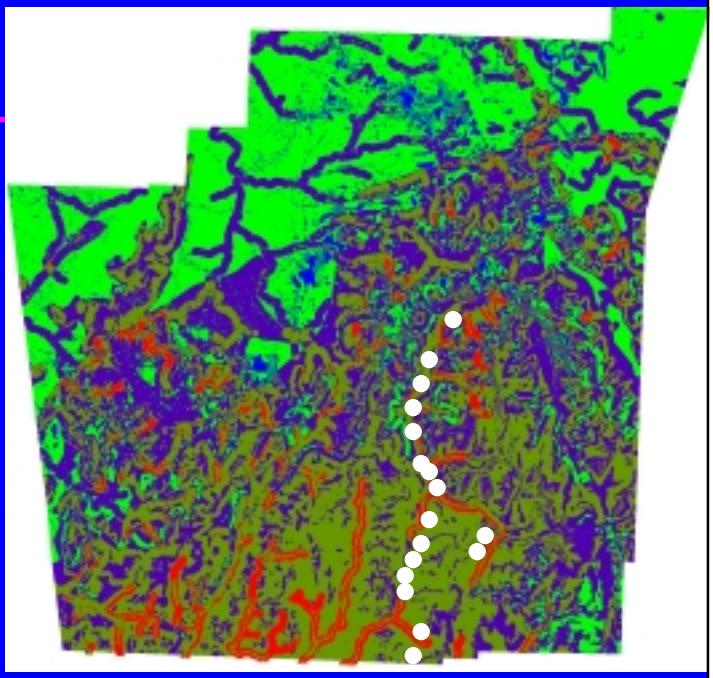
Crawford County



Washington County

Lowest

Highest



Conclusions

- Slope instability prediction using GIS works
- Prediction models are landform specific
- Strongest correlation with soil and geology
- Weakest correlation with elevation and water
- Prediction models are only qualitative
- Need higher resolution data

Future Work

- Add More Slope Failure Data
- Refine DEM Data
- Generate Better Water (Seep) Data
- Refine Soil/Geology Data to County Level
- Incorporate Ground Cover Data
- Replace Boolean Queries

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Questions/Comments